Remarks

Claims 44–73 are pending in the present application. Claims 1–43 have been withdrawn. Claims 44–46, 53, 56, 57, 59–62, 68, 71 and 72 have been rejected under 35 USC 102(b) as being anticipated by U.S. Patent No. 4,963,408 to *Huegli*. Claims 47–51 and 63 - 66 have been rejected under 35 USC 103(a) as being unpatentable over U.S. Patent No. 4,963,408 to *Huegli*. Finally, claims 52, 54–55, 58, 67, 69–70 and 73 have been rejected under 35 USC 103(a) as being unpatentable over U.S. Patent No. 4,963,408 to *Huegli* in view of U.S. Patent No. 6,444,073 to *Reeves et al.*

Independent claim 44 calls for,

a. providing

at least one gas impermeable barrier layer,

at least one structural polymer resin layer disposed coplanar to said barrier layer, and

a gas impregnated thermal insulated core layer,

wherein said at least one gas impermeable barrier layer prevents out-gassing of cell gas from said gas impregnated thermal insulated core layer through said at least one structural polymer resin layer;

b. bonding said at least one gas impermeable barrier layer to said at least one structural polymer layer, thereby forming a laminate liner panel;

c. attaching said laminate liner panel to said thermal insulated core layer.

Finally, independent 61 calls for,

a. providing

at least one gas impermeable barrier layer,

at least one structural polymer resin layer disposed coplanar to said barrier layer, and

b. bonding said at least one gas impermeable barrier layer to said at least one structural polymer layer by heating said at least one gas impermeable barrier layer and said at least one structural polymer resin layer and compressing together said at least one gas impermeable barrier layer and said at least one structural polymer resin layer thereby forming a laminate liner panel,

wherein said at least one gas impermeable barrier layer prevents out-gassing of cell gas from a gas impregnated thermal insulated core layer through said at least one structural polymer resin layer.

Applicants respectfully traverse the rejection of independent claims 44 and 61 as being anticipated in by *Huegli* since *Huegli* alone, or in combination with any other reference, fails to teach, disclose or at the very least suggest providing at least one gas impermeable barrier layer for preventing out-gassing of cell gas from a gas impregnated core.

In particular, *Huegli* discloses a structural unitary composite laminate structure to over come the problem of delaminating under shear conditions.[1] The laminate structure 10 comprises an inner core layer 12 and an outer encapsulating layer 14 co-adhered one to the other by a bonding material.[2] A high shear strength, load-bearing matrix 16 is disposed between inner core layer 12 and outer encapsulating layer 14.[3] The specification expressly states that "[t]he laminate 10 can be fabricated to form a structural product having high strength to weight ratios, excellent insulating properties, durability, *excellent weather resistance, resistance to a wide variety of chemicals, solvents, and staining agents, non-combustibility, waterproof, rot-proof, rodent-resistant.*[4] The matrix is oriented substantially entirely in the load bearing direction so that the unitary composite structure is capable of resisting delamination under conditions requiring high tensile and shear strength.[5] The respective inner core and encapsulating layers are chemically fused together to produce the unitary structure by an adhesive compound such as polyester, vinyl ester and epoxy thermosetting resins.[6]

Load-bearing matrix 16 typically comprises a plurality of load-bearing synthetic filaments, particularly uncrimped, load-bearing synthetic filaments which are physically connected together to prevent movement of the filaments under load conditions.[7] The filaments are provided by filament layers 18 and 20.[8] Filament layers 18 and 20 are held together and to a fibrous mat 26 by stitching 22, and the entire biaxial composite material 16 is held together by knitting material 24.[9]

---

[1] U.S. Patent No. 4,963,408, Col. 2, lns. 51 - 56.
[2] *See id.* at Col. 4, lns. 50 - 55.
[3] *See id.*
[4] *Id.* at 55 - 60 (emphasis added).
[5] *See id.* at Col. 5, lns. 28 - 34.
[6] *See id.* at Col. 7, lns. 46 - 53.
[7] *See id.* at lns. 47 - 57.
[8] *See id.* at lns. 60 - 65.
[9] *See id.* at Col. 5, ln. 66 - Col. 6, ln. 1.

The outer encapsulating layer 14 comprises a surface membrane capable of providing an extended laminate lifespan.[10] Preferably, encapsulating layer 14 is pinhole free to (1) *prevent oxygen during the curing process from reaching the inner structure since co-adhering of the inner core layer and the outer encapsulating layer to the bonding material is inhibited* and (2) prevent UV light from reaching the bonding material. The encapsulating material is chemically resistant to the external effects of alkalines and acids[11] and typically comprises vinyl fluoride polymer.[12]

The *Huegli* laminate is formed by first providing an inner core layer around which a load-bearing matrix is received. The load-bearing matrix includes axial material positioned within the structural matrix to substantially carry the entire load bearing requirement of the composite laminate structure. A bonding material is applied to the load-bearing matrix and the inner core layer, respectively. An encapsulating layer is wrapped about the load-bearing matrix and bonding material and the layers are co-adhered to the bonding material by applying sufficient heat and/or pressure to form the composite laminate structure.

Huegli fails to teach, disclose or at the very least suggest providing a gas impermeable barrier layer for preventing out-gassing from a gas impregnated core. In fact, *Huegli* fails to teach or disclose any type of cell gas impermeable barrier layer. Instead, *Huegli* merely teaches the use of a pin hole free encapsulating layer for preventing oxygen from affecting the adhesive material during curing. A pin hole free encapsulating layer formed from vinyl fluoride polymer or other polymer material will not prevent out-gassing from a gas impregnated core. In particular and referring to Attachment A from the *Polyurethane Handbook,* the thermal conductivity of polyurethane rigid foam is predominantly determined by the composition of the cell gas of the foam.[13] If the rigid foam is faced with a diffusion barrier, equilibrium of the foam cell gas to the atmosphere cannot occur and the thermal conductivity of the foam remains low.[14] It is known to those of skill in the art that only metallic materials are impermeable to foam core cell gas.[15] In prior art wall constructions, it was known to use a heavy sheet of aluminum facing to prevent out-gassing from a gas-

[10] *See id.* at Co. 7, lns. 25 - 27.
[11] *See id.* at lns. 27 - 45 (emphasis added).
[12] *See id.* at Col. 3, lns. 61 - 62.
[13] *Polyurethane Handbook* (1985), Chapter 6, page 255.
[14] *Id.*
[15] *Id.*

impregnated core, which also provides strength and durability to the wall panel at the cost of weight. The claimed invention seeks to overcome the weight disadvantage by providing a laminate composite wall panel that comprises a lightweight structural polymer layer for strength and durability and a gas impermeable barrier layer to prevent cell gas diffusion while minimizing the weight of the composite panel.

CONCLUSION

For at least the reasons stated above, Applicants believe that independent claims 44 and 61 are not anticipated nor made obvious in view of the cited art and are in condition for allowance. Dependent claims 45 - 60 and 62 - 73 directly or indirectly depend from independent claims 44 and 61. These dependent claims recite further limitations and are allowable in their respective combinations. Favorable action by the Examiner and withdrawal of the cited objections and rejections is respectfully requested. The Examiner is invited to call the undersigned in an effort to discuss and resolve any remaining issues. Please charge any additional fees or credit any overpayment to Deposit Account No. 50-1196.

Respectfully submitted,

NELSON MULLINS RILEY
& SCARBOROUGH, L.L.P.

Kyle M. Globerman
Registration No. 46,730
1320 Main Street
Columbia, SC 29201
Office: (404) 817-6204
Fax: (803) 255-9831

ATTACHMENT A

As long as the foam has fine cells, the thermal conductance is primarily due to the first two factors. The thermal conductivity due to convection can be disregarded. The cell structure has a stronger effect on the thermal conductivity. The chemical composition of the cell polymer, in contrast, is of less importance because it only comprises 3 to 6% of the volume. Radiation only needs to be taken into account at densities < 30 kg/m^3 because in this case the cell walls are very thin.

6.3.5.1 Effect of density

As the density increases the thermal conductivity of the cell struts goes up (Fig. 6.25). This increase, however, is not directly proportional to the increase in density. The polymer is increasingly incorporated into the joints and therefore the thermal conductivity barely changes over the density range of 30 to 60 kg/m^3.

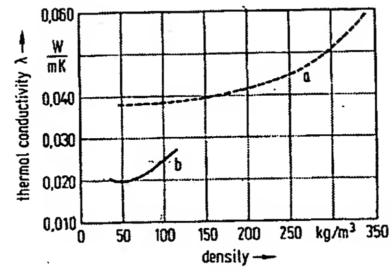

Fig. 6.25. Dependence of thermal conductivity on density
a = blown with carbon dioxide
b = blown with trichlorofluoromethane

6.3.5.2 Effect of the cell gas

In the normal density range (30 to 60 kg/m^3) the thermal conductivity of PU rigid foam is predominately determined by the composition of the cell gas. So it would be expected that foams with a high R-11 content would have especially low thermal conductivities. In practically all cases, however, carbon dioxide is an additional blowing agent and rapidly diffuses from the foam. In this case only R-11 is found in the cells. Since the thermal conductivity of a gas is independent of the pressure as a first approximation, all R-11 blown foams, at this stage, show almost the same initial values of thermal conductivity.

Since air is soluble in the cell structure, it can diffuse into cells over a period of time (see subsection 6.3.3). The thermal conductivity of the cell gas, which has reached equilibrium with the surrounding air, can be calculated from the partial pressures and the thermal conductivity of the individual gases. From this it follows that a high R-11 content in the formulation has a noticeable effect on the final value of the thermal conductivity.

The increase of the thermal conductivity with time [22] is of great importance in thermal technology. Studies in various laboratories and actual field installations over more than a decade show that the thermal conductivity does not approach the value obtained for open celled foams. It asymptotically approaches a final value of approximately 0.025 W/mk. Higher end values are a result of more open cells or an increase in the share of higher conductive gases. The lower the initial value, the greater the difference between the initial and the final value for the thermal conductivity.

The different phases of cell gas diffusion are summarized once more in Table 6.4.

Some consequences for the measuring techniques will result, if one desires to determine specific effects on the thermal conductivity. Foam samples must be used which have already reached equilibrium in the diffusion process. Achievement of the diffusion equilibrium which often requires years, can be accelerated by aging at elevated temperatures (Fig. 6.26). A temperature increase to approximately 50 °C speeds up the process by at least a factor of 10. The equilibration process is faster for thinner foam panels (20 to 30 mm) than for thicker foam panels.

If the rigid foam is faced with a diffusion barrier, the equilibration process cannot occur. The original composition of the cell gas remains unchanged and the low initial thermal conductivity is maintained. This was proven when impermeable facing materials were used.
Only metallic surfaces are impermeable. Aluminum foils are only effective at thicknesses > 50 µm.

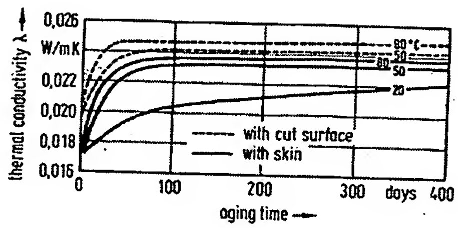

Fig. 6.26. Accelerated increase of thermal conductivity by aging at elevated temperature (50 °C and 80 °C), foam open to diffusion, molded boards of 300 mm × 300 mm × 30 mm

Table 6.4. Phases of the cell gas diffusion (see Fig. 6.27)

Relationship to temperature	Relationship to cell gas analysis
1st Stage (hours) Temporary decrease in thermal conductivity down to the level for a cell gas of pure R 11, with no intermediate condensation maximum.	CO_2 diffuses out rapidly, but air cannot diffuse in from outside at the same rate.
2nd Stage (months or years) Gradual increase in thermal conductivity (between 0 and 20 °C and between 0° and −30 °C). Temperature for intermediate minimum is retained, slight increase in temperature for the intermediate maximum.	Air diffuses in, R 11 concentration remains practically constant.
3rd Stage (decades) Further increase in coefficient of thermal conductivity in the linear temperature range above 0 °C. Temperature for intermediate minimum decreases with time, characteristic relationship to temperature is retained in the R 11 condensation range.	Air diffusion equilibrium is established. In theory, R 11 diffuses out very slowly, though this is of virtually no significance.

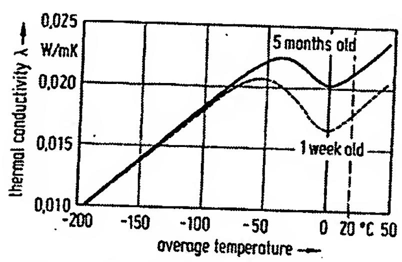

Fig. 6.27. Dependence of thermal conductivity on temperature, foam open to diffusion, molded boards of 30 mm thickness

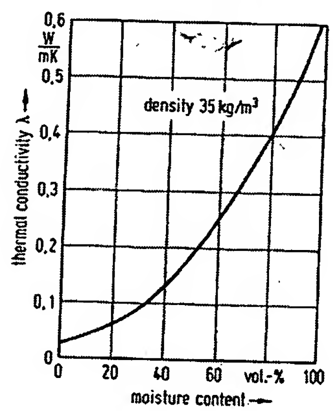

Fig. 6.28. Thermal conductivity depending on the content of moisture at 23 °C